

**What is claimed is:**

5           1. An implantable cable for transmission of a signal to and from a body tissue of a vertebrate, comprising:

          a fiber optic bundle having a surface of non-immunogenic, physiologically compatible material, said fiber optic bundle being capable of being permanently implanted in a body cavity or subcutaneously, said fiber optic bundle having a distal end for implantation at or adjacent to the  
10 body tissue and a proximal end;

          said proximal end being adapted to be coupled to and direct an optical signal source;

          said distal end being adapted to be coupled to an optical stimulator;

15           said fiber optic bundle delivering an optical signal intended to cause an optical stimulator coupled to said distal end to deliver an excitatory stimulus to a selected body tissue, the stimulus being causing the selected body tissue to function as desired.

20           2. The implantable cable as claimed in claim 1, wherein said distal end is adapted to be coupled to a sensor.

          3. The implantable cable as claimed in claim 2; wherein said fiber optic bundle delivering an optical signal from a coupled sensor to said  
25 proximal end.

          4. The implantable cable as claimed in claim 1, further comprising:

a photoresponsive device for converting the light transmitted by said fiber optic bundle into electrical energy, and for sensing variations in the light energy to produce control signals;

a charge accumulating device for receiving and storing the electrical energy produced by the photoresponsive device; and

a discharge control device, responsive to the control signals, for directing the stored electrical energy from the charge accumulating device to a cardiac assist device associated with a heart.

5. The implantable cable as claimed in claim 4, wherein said photoresponsive device is a small surface area photodiode and a large surface area photodiode, said small surface area photodiode sensing variations in the light energy to produce control signals, said large surface area photodiode converting the light transmitted by said photonic lead system into electrical energy.

6. The implantable cable as claimed in claim 4, wherein said photoresponsive device is an array of photodiodes having a first section of photodiodes and a second section of photodiodes, said first section of photodiodes sensing variations in the light energy to produce control signals, said second section of photodiodes converting the light transmitted by said photonic lead system into electrical energy.

7. The implantable cable as claimed in claim 4, wherein said photoresponsive device includes a charge transfer control circuit and a photodiode, said charge transfer control circuit controlling a discharging of a

photodiode capacitance in two separate discharge periods during an integration period of the photodiode such that a first discharge period of the photodiode capacitance provides the sensing of variations in the light energy to produce control signals and a second discharge period of the photodiode capacitance provides the converting the light transmitted by said photonic lead system into electrical energy.

8. The implantable cable as claimed in claim 7, wherein the first discharge period is completed before the second discharge period.

9. The implantable cable as claimed in claim 7, wherein the first discharge period is a shorter time duration than the time duration of the second discharge period.

10. The implantable cable as claimed in claim 7, wherein the integration period corresponds to the sampling period of the light to derive control data.

11. The implantable cable as claimed in claim 7, wherein during the first discharge period, a control signal sensing circuit is connected to said photodiode, and during the second discharge period, said charge accumulating device is connected to said photodiode.

12. The implantable cable as claimed in claim 4, wherein said charge accumulating device is a capacitor.

13. The implantable cable as claimed in claim 4, wherein said charge accumulating device is a rechargeable battery.

14. The implantable cable as claimed in claim 4, wherein said  
5 discharge control device is a controllable switch.

15. An implantable cable for transmission of a signal to and from a body tissue of a vertebrate, comprising:

10 a fiber optic bundle having a surface of non-immunogenic, physiologically compatible material, said fiber optic bundle being capable of being permanently implanted in a body cavity or subcutaneously, said fiber optic bundle having a distal end for implantation at or adjacent to the body tissue and a proximal end;

15 said proximal end being adapted to be coupled to an optical signal receiver;

said distal end being adapted to be coupled to a sensor;

said fiber optic bundle delivering an optical signal from a coupled sensor intended to cause an optical signal receiver coupled to said proximal  
20 end to monitor characteristics of a selected body tissue.

16. An implantable cable for the transmission of power to a body tissue of a vertebrate, comprising:

25 a fiber optic lead having a surface of non-immunogenic, physiologically compatible material and being capable of being permanently implanted in a body cavity or subcutaneously;

said fiber optic lead having,

a proximal end being adapted to be coupled to an optical portal,  
a coupled optical portal being able to receive light from a source  
external to the vertebrate, and

a distal end being adapted to be coupled to a photoelectric  
receiver, a coupled photoelectric receiver being able to convert light  
into electrical energy for use at said distal end.

17. The implantable cable as claimed in claim 16, wherein said distal  
end is adapted to be coupled to a sensor.

18. The implantable cable as claimed in claim 17, wherein said fiber  
optic lead delivering an optical signal from a coupled sensor to said  
proximal end.

19 22. The implantable cable as claimed in claim 16, further comprising:  
a photoresponsive device for converting the light transmitted by said  
fiber optic lead into electrical energy, and for sensing variations in the light  
energy to produce control signals;

a charge accumulating device for receiving and storing the electrical  
energy produced by the photoresponsive device; and

a discharge control device, responsive to the control signals, for  
directing the stored electrical energy from the charge accumulating device to  
a cardiac assist device associated with a heart.

10 23. The implantable cable as claimed in claim <sup>19</sup>22, wherein said  
photoresponsive device is a small surface area photodiode and a large  
surface area photodiode, said small surface area photodiode sensing  
variations in the light energy to produce control signals, said large surface  
5 area photodiode converting the light transmitted by said photonic lead  
system into electrical energy.

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10 24. The implantable cable as claimed in claim <sup>19</sup>22, wherein said  
photoresponsive device is an array of photodiodes having a first section of  
photodiodes and a second section of photodiodes, said first section of  
photodiodes sensing variations in the light energy to produce control signals,  
said second section of photodiodes converting the light transmitted by said  
photonic lead system into electrical energy.

15 25. The implantable cable as claimed in claim <sup>19</sup>22, wherein said  
photoresponsive device includes a charge transfer control circuit and a  
photodiode, said charge transfer control circuit controlling a discharging of a  
photodiode capacitance in two separate discharge periods during an  
integration period of the photodiode such that a first discharge period of the  
20 photodiode capacitance provides the sensing of variations in the light energy  
to produce control signals and a second discharge period of the photodiode  
capacitance provides the converting the light transmitted by said photonic  
lead system into electrical energy.

25 26. The implantable cable as claimed in claim <sup>22</sup>25, wherein the first  
discharge period is completed before the second discharge period.

27. The implantable cable as claimed in claim <sup>22</sup>25, wherein the first discharge period is a shorter time duration than the time duration of the second discharge period.

28. The implantable cable as claimed in claim <sup>22</sup>25, wherein the integration period corresponds to the sampling period of the light to derive control data.

29. The implantable cable as claimed in claim <sup>22</sup>25, wherein during the first discharge period, a control signal sensing circuit is connected to said photodiode, and during the second discharge period, said charge accumulating device is connected to said photodiode.

30. The implantable cable as claimed in claim <sup>19</sup>22, wherein said charge accumulating device is a capacitor.

31. The implantable cable as claimed in claim <sup>19</sup>22, wherein said charge accumulating device is a rechargeable battery.

32. The implantable cable as claimed in claim <sup>19</sup>22, wherein said discharge control device is a controllable switch.

33. An implantable cable for the transmission of power to a body tissue of a vertebrate, comprising:

a fiber optic lead having a surface of non-immunogenic, physiologically compatible material and being capable of being permanently implanted in a body cavity or subcutaneously;

said fiber optic lead having,

a distal end being adapted to be coupled to a sensor, a coupled sensor being able to produce a light signal based on a measured characteristic of a selected body tissue region, and

a proximal end being adapted to be coupled to an optical portal, said optical portal being able to receive light produced by a coupled sensor.

34. An implantable cable for the transmission of power to a body tissue of a vertebrate, comprising:

a fiber optic lead having a surface of non-immunogenic, physiologically compatible material and being capable of being permanently implanted in a body cavity or subcutaneously;

said fiber optic lead having,

a proximal end being adapted to be coupled to an optical portal, a coupled optical portal being able to receive light from a light source,

and

a distal end being adapted to be coupled to a photoelectric receiver, a coupled photoelectric receiver being able to convert light into electrical energy for use at said distal end.

35. The implantable cable as claimed in claim 34, wherein said distal end is adapted to be coupled to a sensor.



33 36. The implantable cable as claimed in claim <sup>32</sup>35, wherein said fiber optic lead delivering an optical signal from a coupled sensor to said proximal end.

5 34 37. The implantable cable as claimed in claim <sup>31</sup>34, further comprising:  
a photoresponsive device for converting the light transmitted by said fiber optic lead into electrical energy, and for sensing variations in the light energy to produce control signals;

10 a charge accumulating device for receiving and storing the electrical energy produced by the photoresponsive device; and

a discharge control device, responsive to the control signals, for directing the stored electrical energy from the charge accumulating device to a cardiac assist device associated with a heart.

15 35 38. The implantable cable as claimed in claim <sup>34</sup>37, wherein said photoresponsive device is a small surface area photodiode and a large surface area photodiode, said small surface area photodiode sensing variations in the light energy to produce control signals, said large surface area photodiode converting the light transmitted by said photonic lead system into electrical energy.

20 36 39. The implantable cable as claimed in claim <sup>34</sup>37, wherein said photoresponsive device is an array of photodiodes having a first section of photodiodes and a second section of photodiodes, said first section of photodiodes sensing variations in the light energy to produce control signals,

said second section of photodiodes converting the light transmitted by said photonic lead system into electrical energy.

37 40. The implantable cable as claimed in claim <sup>37</sup>37, wherein said  
5 photoresponsive device includes a charge transfer control circuit and a  
photodiode, said charge transfer control circuit controlling a discharging of a  
photodiode capacitance in two separate discharge periods during an  
integration period of the photodiode such that a first discharge period of the  
photodiode capacitance provides the sensing of variations in the light energy  
10 to produce control signals and a second discharge period of the photodiode  
capacitance provides the converting the light transmitted by said photonic  
lead system into electrical energy.

37 41. The implantable cable as claimed in claim <sup>37</sup>40, wherein the first  
15 discharge period is completed before the second discharge period.

37 42. The implantable cable as claimed in claim <sup>37</sup>40, wherein the first  
discharge period is a shorter time duration than the time duration of the  
second discharge period.

20 43. The implantable cable as claimed in claim <sup>37</sup>40, wherein the  
integration period corresponds to the sampling period of the light to derive  
control data.

25 44. The implantable cable as claimed in claim <sup>37</sup>40, wherein during the  
first discharge period, a control signal sensing circuit is connected to said

photodiode, and during the second discharge period, said charge accumulating device is connected to said photodiode.

4<sup>2</sup>45. The implantable cable as claimed in claim 3<sup>4</sup>7, wherein said  
5 charge accumulating device is a capacitor.

4<sup>3</sup>46. The implantable cable as claimed in claim 3<sup>4</sup>7, wherein said charge  
accumulating device is a rechargeable battery.

4<sup>4</sup>47. The implantable cable as claimed in claim 3<sup>4</sup>7, wherein said  
10 discharge control device is a controllable switch.

4<sup>5</sup>48. An implantable cable for the transmission of power to a body  
tissue of a vertebrate, comprising:

15 a fiber optic lead having a cylindrical surface of non-immunogenic,  
physiologically compatible material and being capable of being permanently  
implanted in a body cavity or subcutaneously;

said fiber optic lead having,

20 a proximal end coupled to an electro-optical source, said  
electro-optical source converting electrical energy into light energy,  
and

a distal end coupled to a photoelectric receiver, said photoelectric receiver  
converting light energy into electrical energy for use at said distal end.

25 4<sup>6</sup>49. The implantable cable as claimed in claim 4<sup>5</sup>8, further comprising:

a photoresponsive device for converting the light transmitted by said fiber optic lead into electrical energy, and for sensing variations in the light energy to produce control signals;

a charge accumulating device for receiving and storing the electrical energy produced by the photoresponsive device; and

a discharge control device, responsive to the control signals, for directing the stored electrical energy from the charge accumulating device to a cardiac assist device associated with a heart.

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10 47 50. The implantable cable as claimed in claim 46, wherein said photoresponsive device is a small surface area photodiode and a large surface area photodiode, said small surface area photodiode sensing variations in the light energy to produce control signals, said large surface area photodiode converting the light transmitted by said photonic lead system into electrical energy.

15 48 51. The implantable cable as claimed in claim 46, wherein said photoresponsive device is an array of photodiodes having a first section of photodiodes and a second section of photodiodes, said first section of photodiodes sensing variations in the light energy to produce control signals, said second section of photodiodes converting the light transmitted by said photonic lead system into electrical energy.

20 49 52. The implantable cable as claimed in claim 46, wherein said photoresponsive device includes a charge transfer control circuit and a photodiode, said charge transfer control circuit controlling a discharging of a

photodiode capacitance in two separate discharge periods during an integration period of the photodiode such that a first discharge period of the photodiode capacitance provides the sensing of variations in the light energy to produce control signals and a second discharge period of the photodiode capacitance provides the converting the light transmitted by said photonic lead system into electrical energy.

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49  
§ 53. The implantable cable as claimed in claim 52, wherein the first discharge period is completed before the second discharge period.

49  
§ 54. The implantable cable as claimed in claim 52, wherein the first discharge period is a shorter time duration than the time duration of the second discharge period.

15 49  
§ 55. The implantable cable as claimed in claim 52, wherein the integration period corresponds to the sampling period of the light to derive control data.

20 49  
§ 56. The implantable cable as claimed in claim 52, wherein during the first discharge period, a control signal sensing circuit is connected to said photodiode, and during the second discharge period, said charge accumulating device is connected to said photodiode.

25 46  
§ 57. The implantable cable as claimed in claim 49, wherein said charge accumulating device is a capacitor.

<sup>46</sup>  
55 §8. The implantable cable as claimed in claim <sup>46</sup>49, wherein said charge  
accumulating device is a rechargeable battery.

<sup>46</sup>  
5 §9. The implantable cable as claimed in claim <sup>46</sup>49, wherein said  
discharge control device is a controllable switch.

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